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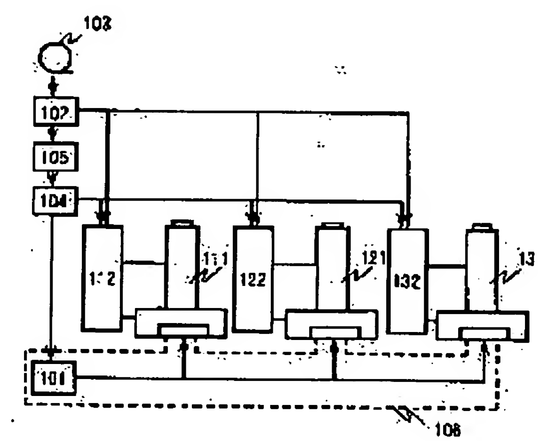
(54) ELECTRON BEAM IMAGE DRAWING METHOD AND SYSTEM THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To perform electron beam image drawing at a high speed while increase of Coulomb's effect is prevented.
SOLUTION: Electron beam image drawing devices 111, 121 and 131 which have different features are combined. Pattern data for performing image drawing are divided into a part for performing image drawing by a variable shaping system, and a part for performing image drawing by a collective figure system by using a data dividing device 102, and two pattern data are formed. Pattern data in the part for performing image drawing by the variable shaping system are assigned to an electron beam image drawing device whose luminance is high, and data in the part for performing image drawing by the collective figure system are assigned to an electron beam image drawing device whose luminance is low. One specimen to be image-drawn is subjected to image drawing by the two devices, independently.



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CLAIMS

[Claim(s)]
[Claim 1] The electron-beam-lithography approach characterized by drawing in one sample using two or more electron optics systems from which brightness differs in the electron-beam-lithography approach which irradiates an electron beam at a sample and draws a pattern.
[Claim 2] In the electron-beam-lithography approach which irradiates an electron beam at a sample and draws a pattern The process which divides the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, The part which draws by said good conversion form method is drawn according to the electron optics system which performs pattern drawing by the good conversion form method. The process which draws the part which draws by said package graphic form method according to the electron optics system which performs pattern drawing by the package graphic form method is included. The brightness of the electron optics system which performs pattern drawing by said good conversion form method is the electron-beam-lithography approach characterized by being higher than the brightness of the electron optics system which performs pattern drawing by said package graphic form method.
[Claim 3] In the electron-beam-lithography approach which uses together a good conversion form method and a package graphic form method, and draws a pattern in a sample The process which divides the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, The process which computes the drawing time amount of said divided pattern data, the electron optics system which performs pattern drawing by the good conversion form method based on said computed drawing time amount, and the process which adjusts the brightness of the electron optics system which performs pattern drawing by the package graphic form method, The electron-beam-lithography approach characterized by including the process which draws in one sample according to the electron optics system which performs pattern drawing by said good conversion form method, and the electron optics system which performs pattern drawing by said package graphic form method.
[Claim 4] It is an electron-beam-lithography system including the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. A pattern division means to divide the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, A drawing time amount calculation means to compute the drawing time amount of said divided pattern data, A means to adjust the brightness of the electron optics system which performs pattern drawing by said good conversion form method based on said computed drawing time amount, and the brightness of the electron optics system which performs pattern drawing by said package graphic form method, It has a sample conveyance means to convey a sample, between the electron optics system which performs pattern drawing by said good conversion form method, and the electron optics system which performs pattern drawing by said package graphic form method. The electron-beam-lithography system characterized by drawing in one sample using the electron optics system which performs pattern drawing by said good conversion form method, and the electron optics system which performs pattern drawing by said package graphic form method.
[Claim 5] A means to perform the exposure amendment operation for the proximity effect correction of the pattern data which draw by being an electron-beam-lithography system including the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method, A pattern division means to divide the pattern data by which the dose amendment operation was carried out into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, A drawing time amount calculation means to compute the drawing time amount of said divided pattern data, A means to adjust the brightness of the electron optics system which performs pattern drawing by said good conversion form method based on said computed drawing time amount, and the brightness of the electron optics system which performs pattern drawing by said package graphic form method, It has a sample conveyance means to convey a sample, between the electron optics system which performs pattern

drawing by said good conversion form method, and the electron optics system which performs pattern drawing by said package graphic form method. The electron-beam-lithography system characterized by drawing by carrying out proximity effect correction to one sample using the electron optics system which performs pattern drawing by said good conversion form method, and the electron optics system which performs pattern drawing by said package graphic form method.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electron-beam-lithography approach and electron-beam-lithography system which are used for processing of a semiconductor integrated circuit, the photo mask for semi-conductor circuit apparatus, etc., and drawing.
[0002]
[Description of the Prior Art] Detailed-ization of the circuit pattern which forms LSI with the densification of a semiconductor circuit made into representation and high integration is progressing quickly. In order for an electron beam lithography to form a detailed pattern, it is an effective means, but in order to apply to a production site, the still higher throughput is demanded.
[0003] Many of electron beam exposure systems use the so-called good conversion form method which forms the beam of an adjustable rectangle. However, since the circuit pattern made it detailed, the number of patterns per sample increased and the further high throughput was required, the area beam of a good conversion form method was utilized, a mass of aperture diaphragm with a specific function was irradiated, and the package graphic form method which draws with the electron beam of a pattern configuration was developed. Moreover, opening of a package graphic form is enlarged like the publication to JP,10-199796,A, and the method which draws by scanning an opening top, and the method which draws by synchronizing this, beam deflection, and a sample stage while moving package opening to the patent No. 3034285 official report like a publication are also proposed. JP,5-251317,A and Japanese who developed this Journal OBU Applied The method which prepares the opening mold or dispersion mold mask of a semiconductor integrated circuit full chip like an optical imprint, and imprints with the beam of a comparatively big area like physics (Jpn.J.Appl.Phys.), 34 volumes (1995), and a 6658-page publication is proposed. Since all these methods are the approaches of drawing while projecting a mask image on a sample with an electron lens and positioning with deflecting system, on these specifications, they name these generically and call them a package graphic form method.
[0004]
[Problem(s) to be Solved by the Invention] The main factor which determines the throughput of the above electron beam exposure systems is the current value of the electron beam (one shot) which irradiates at once on a sample. When a beam current value is enlarged, there is a problem on which the pattern configuration formed for the beam dotage by the coulomb effectiveness deteriorates. Therefore, although the good conversion form method which draws in a small beam area is good if current density which broke the beam current value by beam area is made high, by the package graphic form method which imprints a big area relatively, a current value will become large and a pattern configuration will deteriorate. On the other hand, if current density is made low, the drawing time amount in a good conversion form method will become long.
[0005] In case one sample is drawn like a publication to JP,11-219879,A as opposed to this problem, by the good conversion form method, it is [area / beam] small high in current density, and if it draws with the greatest current value in the range which changes current density and the coulomb effectiveness allows so that current density may be relatively made small for beam area greatly, writing speed will improve with a package graphic form method. However, in this example, as a means to change current density, since the condensing lens is used, a beam spread angle will also change to coincidence at the same time current density changes. The beam dotage by the coulomb effectiveness is proportional to an outline current value, and in inverse proportion to an aperture angle. Moreover, current density is proportional to the square of ******** in this case. Therefore, under the amount regularity of currents, an aperture angle will be set to 1/root2 as for 1/2 in current density with a condensing lens, and the coulomb effectiveness will increase.
[0006] This invention aims at performing an electron beam lithography at a high speed, preventing increase of the coulomb effectiveness. Furthermore, it aims at offering the electron-beam-lithography system which can realize the electron-beam-lithography approach for using a different combination effectively, and this.

[0007]
[Means for Solving the Problem] In order to attain said purpose, in this invention, an electron beam lithography is performed at a high speed by combining a different drawing method and an electron beam exposure system with current density. First, it divides into the part which draws the pattern data which draw by the good conversion form method with data division equipment, and the part which draws by the package graphic form method, and two pattern data are created. Next, the pattern data of the part which draws in a good conversion form are assigned to an electron beam exposure system with high brightness, and the part which draws by the package graphic form method is assigned to an electron beam exposure system with low brightness. By drawing separately one sample which should draw with these two equipments, it can draw with the optimal current density and high-speed drawing is attained. Brightness is the amount of currents per unit area unit solid angle. Therefore, it becomes possible to change current density, without opening by changing brightness and changing an angle, and Lycium chinense becomes possible without changing the coulomb effectiveness under the amount regularity of currents.
[0008] The number of partitions of pattern data should just be made to draw by not being restricted to two, but dividing pattern data further depending on the difference of the drawing time amount between two equipments, and the magnitude of a package graphic form, and assigning each pattern data to another drawing equipment.
[0009] That is, the electron-beam-lithography approach by this invention is characterized by drawing in one sample using two or more electron optics systems from which brightness differs in the electron-beam-lithography approach which irradiates an electron beam at a sample and draws a pattern.
[0010] Two or more electron optics systems can be made into two or more combination in the electron optics system which performs pattern drawing by the good conversion form method, the electron optics system which performs pattern drawing by the package graphic form method, and the electron optics system which performs pattern drawing of a large area by the imprint method. These electron optics systems may be included in one electron beam exposure system, and may constitute an electron beam exposure system with separate each.
[0011] In the electron-beam-lithography approach which the electron-beam-lithography approach by this invention irradiates an electron beam again at a sample, and draws a pattern The process which divides the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, The part which draws by the good conversion form method is drawn according to the electron optics system which performs pattern drawing by the good conversion form method. The brightness of the electron optics system which performs pattern drawing by the good conversion form method is characterized by being higher than the brightness of the electron optics system which performs pattern drawing by the package graphic form method including the process which draws the part which draws by the package graphic form method according to the electron optics system which performs pattern drawing by the package graphic form method.
[0012] You may make it divide further the part which draws by the package graphic form method on the occasion of division of pattern data according to the class or area of a package graphic form. Moreover, you may make it divide further the pattern data of a method with the long drawing time amount of the part which draws by the good conversion form method based on the computed drawing time amount, and the part which draws by the package graphic form method.
[0013] In the electron-beam-lithography approach which the electron-beam-lithography approach by this invention uses together a good conversion form method and a package graphic form method again, and draws a pattern in a sample The process which divides the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, The process which computes the drawing time amount of the divided pattern data, the electron optics system which performs pattern drawing by the good conversion form method based on the computed drawing time amount, and the process which adjusts the brightness of the electron optics system which performs pattern drawing by the package graphic form method, It is characterized by including the process which draws in one sample according to the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method.
[0014] The electron-beam-lithography system by this invention is an electron-beam-lithography system including the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. A pattern division means to divide the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, A drawing time amount calculation means to compute the drawing time amount of the divided pattern data, A means to adjust the brightness of the electron optics system which performs pattern drawing by the good conversion form method based on the computed drawing time amount, and the brightness of the electron optics system which performs pattern drawing by the package graphic form method, It has a sample conveyance means to convey a sample, between the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. It is characterized by drawing in one sample using the electron optics system which performs pattern

drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method.
[0015] The electron-beam-lithography system by this invention is an electron-beam-lithography system which includes the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method again. A means to perform the exposure amendment operation for the proximity effect correction of the pattern data which draw, A pattern division means to divide the pattern data by which the dose amendment operation was carried out into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, A drawing time amount calculation means to compute the drawing time amount of the divided pattern data, A means to adjust the brightness of the electron optics system which performs pattern drawing by the good conversion form method based on the computed drawing time amount, and the brightness of the electron optics system which performs pattern drawing by the package graphic form method, It has a sample conveyance means to convey a sample, between the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. It is characterized by drawing by carrying out proximity effect correction to one sample using the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method.
[0016] The electron optics system which performs pattern drawing by the good conversion form method of said electron-beam-lithography system, and the electron optics system which performs pattern drawing by the package graphic form method may be included in one electron beam exposure system, and may constitute an electron beam exposure system with separate each.
[0017] Moreover, said electron-beam-lithography system combines between two or more electron beam exposure systems in a vacuum chamber, and, as for a sample conveyance means, it is desirable to move in the inside of the vacuum chamber, and to convey a sample to an electron beam exposure system. Moreover, a sample conveyance means is conveyed in an electron beam exposure system, carrying a sample in a sample maintenance means, and a superposition error can be reduced if it is made to draw, carried in the sample maintenance means.
[0018] In case it draws by setting the divided pattern data by one sample using two or more electron optics systems, it is desirable to use optical alignment mark detection equipment. Moreover, it is desirable that each doubling drawing algorithm at the time of drawing by setting the divided pattern data by one sample using two or more electron optics systems is the same. The electron-beam-lithography approach of this invention or an electron-beam-lithography system can be used for pattern drawing of a semi-conductor circuit apparatus or the photo mask for semi-conductor circuit apparatus.
[0019]
[Embodiment of the Invention] Hereafter, this invention is explained to a detail using a drawing. First, the configuration of the electron beam exposure system used by this invention is explained. The example of the electron beam exposure system of a package graphic form method is shown in drawing 14 . The example shown here is equipment which parts other than a package graphic form can also draw [of the good conversion form method using the variable shaped beam method which can change the magnitude of a ** type beam].
[0020] The electron beam 1202 emitted from the electron gun 1201 is irradiated on the 1st mask 1203 with rectangular opening, and image formation is further carried out on the 2nd mask 1205. The image of the 2nd mask 1205 draws by carrying out a projection deviation with reducing glass 1206 and the object deviation lens 1207, and being projected on the sample 1208 to which the sensitization agent was applied. This part is an electron optics system. At this time, opening of two or more pattern configurations established beforehand is chosen as the 2nd mask 1205 with the selection deflecting system 1204. Except the field which can be deflected with the object deviation lens 1207, it draws by moving the sample 1208 installed on X-Y stage 1209 with the X-Y stage control unit 1213. The whole drawing is systematically controlled by the drawing control unit 1210 according to drawing pattern data. Migration of the 2nd mask 1205 is performed by the mask migration device 1211, and it is controlled by the migration device control unit 1212 according to a drawing pattern. It can also draw moving the 2nd mask 1205. Moreover, there is also a method which draws by carrying out the synchronized drive of the 2nd mask 1205 and X-Y stage 1209 using larger opening than the magnitude of the electron beam irradiated on the 2nd mask 1205.
[0021] The plan of the 2nd mask 1205 is illustrated to drawing 15 . On this 2nd mask 1205, the opening 1301 for package graphic forms is arranged around the opening 1302 for good conversion forms. In this example, five openings 1301 for package graphic forms are selectable at selection deflecting system.
[0022] Next, the example of the electron beam exposure system of an imprint method is shown in drawing 16 . A mask 1405 top is partially irradiated to the electron beam 1402 generated in the illumination system 1401 containing an electron source, acceleration space, a lens, etc. with a lens 1403 and deflecting system 1404. There are two methods, the dispersion mold which formed the pattern with the quality of the material with the large atomic number on the silicon thin film etc., and the opening mold which makes a hole in a silicon thin film, in this mask 1405. It is

the method with which all give contrast with the difference of dispersion with the pattern section and the non-pattern section. In a mask 1405, incidence of the beam passed or scattered about is carried out to the 1st projection lens 1406 by deflecting system 1407, and only the scattered beams are cut by the limit aperture 1408. The beam which passed the limit aperture 1408 is positioned by the 2nd projection lens 1409 and deflecting system 1410, and is projected on a sample 1411. The 1st projection lens 1406 and the 2nd projection lens 1409 have doublet composition, and a projection scale factor is decided by the ratio of the focal distance of two lenses. For example, the pattern of 1mm angle is reduced to one fourth on a mask 1405, and it projects on 250-micrometer square on a sample. This configuration can also project aberration, such as distortion and dotage, few. Also mechanically, it moves to deviating with deflecting system 1404, and coincidence, and the current beam position on a mask 1405 draws synchronizing with the stage (not shown) in which a sample 1411 is carried. .

[0023] The function and configuration which draw while irradiating a mask with an electron beam, projecting a mask image on a sample with two drawing equipments shown above and determining an electron beam location on deflecting system and a sample stage are the same. Therefore, on these specifications, these are named generically and it considers as a package graphic form method.

[0024] Hereafter, the detail of this invention is explained using a drawing.

[Gestalt 1 of operation] Drawing 1 is the system configuration Fig. showing an example of the electron-beam-lithography system by this invention. Electron beam exposure systems 111, 121, and 131 are electron beam exposure systems same type as having been shown in drawing 14 . The pattern data 103 which should draw are divided into good conversion form data and package graphic data by data division equipment 102. And it is sent to the control units 112, 122, and 132 which control electron beam exposure systems 111, 121, and 131, respectively. The sample drawn moves by the sample transport device 101 which operates within a vacuum chamber 106 between electron beam exposure systems 111, 121, and 131, and drawing is performed according to the divided pattern data. Actuation of drawing is the same as what was shown by drawing 14 .

[0025] The drawing time amount of each divided pattern data is computed with the drawing time amount arithmetic unit 105. Drawing time amount multiplies the sum of the shot residence time decided from the sensibility and current density of a sensitization agent of a sample, and the beam deflection latency time by the shots per hour, and if the whole overhead time is added further, it can ask for it. Here, suppose that the drawing time amount of for example, the package graphic form section was twice [about] the drawing time amount of the good conversion type section. In this case, it is the most efficient, if the good conversion type section is drawn with an electron beam exposure system 111 and the package graphic form section is drawn with electron beam exposure systems 121 and 131. Moreover, the brightness of each electron optics system may be decided so that it may become the current density of an integral multiple (here twice).

[0026] The sequence of drawing is shown in drawing 2 . First, equipment 111 is loaded with a sample 2 and equipment 131 is loaded with equipment 121 and a sample 3 for a sample 1, respectively. Since drawing of the sample 1 by the electron beam exposure system 111 which draws the good conversion type section is ended by the time amount of the one half of other equipments, after drawing termination of a sample 1, a sample 1 is evacuated and drawing of a sample 4 is started. next, after the drawing termination by each equipment and a sample 1 -- a sample 3 is moved to equipment 111 and evacuation and a sample 4 are moved for a sample 2 to equipment 121 to equipment 131. After drawing with an electron beam exposure system 111, a sample 2 serves as drawing termination, it loads equipment 111 with a sample 3 continuously, and starts drawing. It means that drawing of samples 3, 4, and 1 is mostly ended to coincidence, and, as for all of four samples, drawing was performed. Henceforth, this procedure is repeated similarly. These procedures are controlled by the drawing procedure control unit 104 based on the drawing time amount found with the drawing time amount arithmetic unit 105.

[0027] Drawing 3 is the example of the pattern which draws. They are the part which a part when it is the pattern of a repeat among the drawing patterns 31 draws with a package graphic form, and the part into which a lower part draws in a good conversion form. This drawing pattern 31 is divided and the pattern of the package graphic form pattern 32 and the good conversion form pattern 33 is generated. The good conversion form pattern 33 divided with the data division equipment 102 shown in drawing 1 is sent to a control unit 112, and the package graphic form pattern 32 is sent to control units 122 and 132.

[0028] Next, both are described about the current density of a formula. For example, the magnitude of the pattern which draws by the electron-beam-lithography system is about 0.1 micrometers. On the other hand, the magnitude of a package graphic form is for example, 5-micrometer angle, and there are many patterns with opening which dozens of% of beam usually passes. Here, if current density is the amount of currents, then the same current density per unit area, the beam current of a package graphic form will become large 10 or more times as compared with a good conversion form.

[0029] On the other hand, if the beam dotage by the coulomb effectiveness has the the same specification of an electron optics system, it will become large proportionally mostly at a beam current value. Therefore, if the beam current of a package graphic form is restricted by the beam dotage by the coulomb effectiveness, and the current

density in a good conversion form becomes small and it approves to the same beam dotage as a package graphic form, it is possible to raise current density. It is difficult practically to realize the electron optics system which must perform the change of the good conversion type section and the package graphic form section at the high speed of beam deflection latency-time extent, and changes current density at this rate by the conventional drawing approach. Therefore, it becomes possible [the electron optics system], if the electron optics system which draws a package graphic form makes current density of the electron optics system which performs drawing of current density 5 A/cm2 and a good conversion form a setup called 40 A/cm2 beforehand to draw efficiently, for example. For example, by the pattern of drawing 3 , if 38 shots and a package graphic form set [a good conversion form] up the current density of the electron optics system of a good conversion form method by nine shots by 8 times the current density of the electron optics system of a package graphic form method, the drawing time amount of good conversion form drawing will serve as the abbreviation 1/2 of package graphic form drawing.

[0030] There are some approaches as a means to change current density. For example, the include angle which expects an electron gun, without changing a crossover location using a condensing lens as the Prior art described previously is changeable. However, by this approach, since brightness does not change, a beam spread angle will also change to current density and coincidence. The beam dotage by the coulomb effectiveness is proportional to an outline current value, and in inverse proportion to an aperture angle. On the other hand, a current value is proportional to the square of an aperture angle. For example, when setting current density of current density 40 A/cm2 to one fourth with a condensing lens by aperture angle 5mrad, in order to set current density to one fourth, it is necessary to open and to set an angle to one half of 2.5mrad(s). However, since the coulomb effectiveness is in inverse proportion to an aperture angle, if the same current is used by the good conversion form method and the package graphic form method, beam dotage will double in current density 40 A/cm2. Therefore, by this approach, it does not become solution of the beam dotage by the coulomb effectiveness.

[0031] Current density can be raised without opening on the other hand, if the brightness of an electron gun is raised, and changing an angle. The approach of raising brightness has a method of changing the electron source itself. However, it is a simple approach to change the electrical potential difference of the approach of changing heating conditions, and the electrode (Wehnelt) which presses down generating of a thermoelectron in the case of a source of a thermoelectron like LaB6. Moreover, there are also an approach of adding and controlling the electrode which brings about a lens operation in an electron gun, and the approach of superimposing a magnetic lens on an electron gun. For example, when the thermoelectron gun of LaB6 is used, the brightness which realizes current density 40 A/cm2 by aperture angle 5mrad is 5x105 A/cm2 str extent. Since current density is proportional to brightness, if it is set as 6.25x104 A/cm2 str by raising the Wehnelt electrical potential difference or it lowers whenever [stoving temperature], current density will become 5 A/cm2. In this example, brightness was changed by raising the Wehnelt electrical potential difference. Since an aperture angle did not change at this time, even if it used the same current by the good conversion form method and the package graphic form method, the beam dotage by the coulomb effectiveness was not able to change, but was able to use the beam current value same as a result.

[0032] Although the above-mentioned example shows an example with the short drawing time amount of a good conversion form method, depending on the pattern which draws, the drawing time amount of a good conversion form method may be long. In that case, what is necessary is to draw the good conversion type section with electron beam exposure systems 111 and 121, and just to draw the package graphic form section with an electron beam exposure system 131.

[0033] An electron beam lithography must be performed in a vacuum, in order to use an electron beam. Usually, after carrying out evacuation of the sample in a chamber different from a sample stage before drawing, it loads on a sample stage. In drawing continuously among two or more equipments, the futility of time amount performs atmospheric-air-izing and exhaust air each time. Therefore, a dead time will be lost, if between each equipment is combined in a vacuum chamber and a sample is moved within a vacuum chamber. In drawing 1 , the part surrounded with the broken line is a vacuum chamber 106, and the sample transport device 101 operates within this vacuum chamber 106. If a sample transport device can treat two or more samples at a time, the effectiveness of sample exchange will become good.

[0034] It is drawing 4 which showed the example of the mounting gestalt of equipment. In this example, the sample transport device 44 which operates within a vacuum is installed in the center of three electron beam exposure systems 41, 42, and 43. Between this sample transport device 44 and three sample stages, sample exchange is possible. If there are two or more arms of the sample transport device 44 at this time, it will be efficient and sample exchange will be attained. Moreover, a sample transport device performs sample transfer with the sample cassette 46 in atmospheric air by sample exchange with the evacuation room 45. The evacuation room 45 is the most efficient, if it exhausts and-izing of the sample (here three) of the number of electron beam exposure systems and the same number can be carried out [atmospheric air] to coincidence.

[0035] Superposition precision becomes important in drawing the same sample with two or more drawing equipments. There is retention form of a sample as one of the factors of a superposition error. When a sample is

carried in the sample supporting structure, a superposition error may increase by the curvature of a sample, distortion, etc. In order to avoid such an error, it draws by moving between two or more drawing equipments the whole sample supporting structure 51 shown in drawing 5 . Drawing 5 (a) shows the example of the sample supporting structure 51 in which drawing 5 (b) carried the glass mask 53 for the example of the sample supporting structure 51 which carried the wafer 52.
[0036] When performing an electron beam lithography, the CAD data for an LSI design are changed into the data for electron beam exposure systems, and delivery and a control device draw to the control device of an electron beam exposure system by controlling the deflecting system of an electron beam control device etc. based on the data. In case data are changed, the part which draws with a package graphic form deletes the pattern data of the part, and replaces them with the sign which shows a package pattern.
[0037] Actuation of pattern data division equipment is explained using drawing 6 R> 6. The pattern data 61 for electron beam lithographies consist of pattern data divisions 63 in which the sign which usually shows the magnitude Sagitta label of the drawing condition part 62 which has described the magnitude of the whole pattern, a number, the minimum drawing unit, etc., and each pattern, and a package graphic form is stored. This pattern data 61 is read and it divides into the package graphic form pattern data 67 which consist of the good conversion form pattern data 66 and the drawing condition part 62 which consist of a drawing condition part 62 and good conversion form data division 64, and package graphic form data division 65.
[0038] The processing flow of pattern data division is shown in drawing 7 . The pattern data 61 are read (step 11), and since the drawing condition part 62 is common, the drawing condition part 62 is outputted to the good conversion form pattern data 66 and the package graphic form pattern data 67, respectively (step 12). Next, the classification of the data contained in the pattern data division 63 is distinguished (step 13), good conversion form data are outputted to the good conversion form pattern data 66 (step 14), and package graphic data are outputted to the package graphic form pattern data 67 (step 15). It remains at step 16 and the existence of data is judged, and processing of step 13 to the step 16 is repeated until the output of all pattern data finishes. Consequently, two pattern data are created. At this time, the mask of a package graphic form shall be prepared beforehand. The package graphic data of the mask which is not prepared are outputted to good conversion form data. In addition, software may perform this data division or you may carry out by hardware.
[0039] [Gestalt 2 of operation] In the drawing approach shown in the gestalt 1 of operation, in the case of drawing by the package graphic form method, generally, since many patterns can be incorporated so that the area of the package graphic form which can draw is large, writing speed becomes quick by one exposure. However, in order to imprint distortion and dotage for a big area few, the component of the electron optics system of deflecting system etc. must be increased, and complicated control must be performed. for this reason -- for example, the details of the electron optics system which draws the package graphic form of 5-micrometer angle and the package graphic form of 250-micrometer angle on a sample differ. On the other hand, since the area of a package graphic form is large, the beam dotage by the coulomb effectiveness becomes small. As the gestalt 1 of operation described, in package graphic form drawing of 5-micrometer angle, the brightness of LaB6 electron source is 5x105 A/cm2 str extent. On the other hand, in package graphic form drawing of 250-micrometer angle shown in drawing 16 , since a mask projection scale factor is 1/4, it is necessary to irradiate a mask top with the beam of 1mm angle. For this reason, the electron source itself is enlarged and the large area is irradiated. For this reason, brightness is set as 1x102 - 1x103 A/cm2 str extent.
[0040] As shown in drawing 8 , a semiconductor integrated circuit 71 may divide and design the circumference circuit which connects these with the block with specific functions, such as the memory sections, such as RAM and ROM, the CPU section, the DSP section, and the gate array section. The block with a specific function occupies a comparatively big area on a semiconductor integrated circuit. For example, as for each functional block, the magnitude of a semiconductor integrated circuit 71 has the 2-5mm side to 10-20mm angle. Moreover, these functional block will be frequently used in many cases, once a design is completed. If these functional block draws using the mask of functional block which is some full chips in the imprint method in which full chip drawing as shown in drawing 16 is possible, synthetic writing speed will improve. It is necessary to divide the part of these functional block from pattern data at this time. The area of a package graphic form is sufficient as the criteria of division, and they may embed the sign which specifies functional block at the time of an integrated-circuit design into pattern data, and may follow the sign.
[0041] What is necessary is an electron beam exposure system 111 to perform a circumference circuit, and to draw in the good conversion type section, and just to draw functional block of a large area with an electron beam exposure system 121 using the system shown in drawing 1 which combined three electron beam exposure systems 111, 121, and 131 as a drawing system, using an electron beam exposure system 131 as an imprint mold for drawing of the package graphic form section of small area. Thus, with the gestalt of this operation, the imprint method conventionally used for the full chip imprint is applied partially. Although reuse cannot do the mask of a full chip comparatively [with high manufacture cost], if it uses for chisels, such as the reusable memory section, like this example, it becomes possible to control total mask cost, and the merit is large.

[0042] Moreover, there are some which need many classes of package graphic form depending on the pattern which draws. Usually, a package graphic form is chosen by deflecting an electron beam in electromagnetism. There is an upper limit in a selectable number on the structure of a system, and when using the number beyond it, it is necessary to move the mask for package graphic forms mechanically. Here, two electron optics systems for package graphic form drawing are prepared, and if the mask with which the configurations of each package graphic form differ is prepared, the twice as many parenchyma [as this] number of selections can be obtained.
[0043] The flow of the pattern data division processing at the time of being based on the area of a package graphic form to drawing 9 is shown. First, like the gestalt 1 of operation, pattern data are read (step 21) and a drawing condition part is outputted to good conversion form pattern data and package graphic form pattern data, respectively (step 22). Next, the classification of the data contained in pattern data division is distinguished (step 23), and good conversion form data are outputted at good conversion form pattern data (step 24). the maximum package graphic form area which package graphic data can draw [of each electron optics system] -- a reference value -- carrying out -- size relation with this reference value -- judging (step 25) -- a facet -- the package graphic data 1 (step 26) of a product and the package graphic data 2 (step 27) of a large area are outputted. It remains at step 28 and the existence of data is judged, and processing of step 23 to the step 28 is repeated until the output of all pattern data finishes.
[0044] Although the pattern data division processing shown in drawing 9 is based on the area of a pattern, step 15 in drawing 9 may be replaced with the class judging of a package graphic form, and two package graphic data may be outputted according to a class.
[0045] [Gestalt 3 of operation] In the drawing approach shown in the gestalt 1 of operation, when dividing pattern data and drawing with two or more electron beam exposure systems, a difference may appear in the drawing time amount between each equipment. By the pattern by which the graphic form which is greatly dependent on the pattern which should draw, for example, is regular occupies most, it becomes most drawing this according to a good conversion form in the pattern which the rate of package graphic form drawing becomes large, and is irregular. If a difference is in drawing time amount, writing speed will be restricted to the longer one of drawing time amount, and futility will produce it.
[0046] Drawing time amount is decided with parameters, such as a shots per hour, current density, sensibility of a sensitization agent, the beam deflection latency time, and stage transit time. Therefore, if the contents of the pattern which should draw are understood, it will become computable [drawing time amount]. What is necessary is to divide the pattern data of the longer one further and just to lessen the difference of drawing time amount, if there is a twice [more than] as many difference as this at this time, for example, drawing time amount. Moreover, when there are three electron beam exposure systems, pattern data with longer drawing time amount are divided unconditionally, and you may make it surely generate three pattern data for example.
[0047] The flow of the latter example is shown in drawing 10 . First, like the gestalt 1 of operation, pattern data are read (step 31) and a drawing condition part is outputted to good conversion form pattern data and package graphic form pattern data, respectively (step 32). Next, the classification of the data contained in pattern data division is distinguished (step 33), good conversion form data are outputted to good conversion form pattern data, and (step 34) and package graphic data are outputted to package graphic form pattern data (step 35), respectively. It remains at step 36 and the existence of data is judged, and processing of step 33 to the step 36 is repeated until the output of all pattern data finishes. In this way, pattern data are divided into good conversion form data and package graphic data. Then, the drawing time amount of each pattern data is calculated (step 37), and drawing time amount is judged (step 38). At this time, if the drawing time amount in the direction of good conversion form pattern data excels, good conversion form pattern data will be divided further (step 39). If the drawing time amount in the direction of package graphic form pattern data excels, package graphic form pattern data will be divided further (step 40). Thus, drawing time amount can be shortened by drawing using three electron beam exposure systems.
[0048] [Gestalt 4 of operation] By the drawing approach shown in the gestalt of said the operation of each, in order to divide one pattern and to draw using two or more electron beam exposure systems in one sample, the superposition precision of the pattern between two or more equipments becomes important. As for the superposition in an electron beam lithography, it is common to detect two or more mark locations on a sample using an electron beam, and to draw according to a configuration. However, when the current density and beam area of an electron beam differ from each other like this invention, the mark location detection precision which is to the base of superposition precision may change with between each equipment.
[0049] In order to cancel this difference, it is good to use the mark location detection not using an electron beam. The optimal means is optical detection from a viewpoint of detection precision. An example is shown in drawing 11 R> 1. Only the parts of the objective lens 1207 of the electron beam exposure system explained by drawing 14 , a sample 1208, and X-Y stage 1209 are shown in drawing 11 . Drawing 11 (a) is an example which measures the same location as an electron beam 1202. Incidence of the light is aslant carried out from the light source 91 to a sample, optical mark detection ****** 92 detects the image on a sample, and a location is measured. Drawing 11 (b) is an example which measures a different location in an electron beam 1202. If the relative position of optical mark detection

****** 93 and an electron beam 2 is proofread beforehand, it will become convertible [a mark location and a drawing location]. At this time, what doubled for photodetection what was doubled for electron beam detection is sufficient as the configuration of a mark.

[0050] [Gestalt 5 of operation] As the gestalt 4 of operation described, in case superposition drawing is performed, it is common to detect two or more mark locations on a sample, and to draw according to a configuration. Although precision will improve if the number of the marks to detect is increased, detection takes time amount. Therefore, the number of the marks detected in the range which can secure a required precision was limited, and the pattern which should draw has taken the approach of diffusing an error according to a location.

[0051] A wafer 1001 is used for a sample at drawing 12 , and the example in the case of drawing two or more chips 1002 is shown. Indispensable mark location detection is detection of the wafer alignment mark 1003 in the pattern area exterior. If these two or more marks are detected, the position error and rotational error when loading equipment with a sample are computable. What is necessary is just to draw based on this value as chip arrangement. In order to perform highly precise drawing, two or more chip alignment marks 1004 of the perimeter of a chip can be detected, and an X-Y stage migration error and a chip array error can be reduced. For example, the approach of taking four angles and cores of the whole chip, and the whole chip may be divided up and down, and you may draw by doubling in the block unit for every six chips. Moreover, the mark location of four angles may be detected for every chip, and you may draw according to this.

[0052] If an algorithm which was explained above is made the same with each electron beam exposure system, the difference between the equipment of a superposition error will be made to min. However, you measure separately a parameter which is different with each equipments, such as the shape of how to move an X-Y stage and a distorted form of an electron beam deviation, and, naturally make it reflected in superposition drawing.

[0053] [Gestalt 6 of operation] The proximity effect is in a problem peculiar to an electron beam lithography. It is the practical approach of amending the proximity effect at a high speed to calculate extent of effect beforehand according to the roughness and fineness of the pattern which should draw, and to change the exposure at the time of drawing. Since the proximity effect is influenced of all surrounding patterns, if it divides drawing data like this invention and a proximity-effect-correction operation is performed after that, it cannot obtain a right result. In the system shown in drawing 1 , an area consistency map is computed there by adding the exposure amendment calculation function for performing proximity effect correction to data division equipment 102. And in advance of data division, an area consistency map operation is performed to data division and coincidence. Drawing is started after sending the pattern data and the area consistency map which were divided here to control units 112, 122, and 132, respectively.

[0054] The exposure amendment calculation function may be built in the control unit of equipment. In that case, delivery area consistency map calculation is first performed [data before being divided] for example, for control unit 112 **. This map is transmitted to control devices 122 and 132, and the pattern data divided by data division equipment 102 based on this area consistency map are drawn.

[0055] [Gestalt 7 of operation] The production process of a semiconductor integrated circuit which used the electron-beam-lithography approach of this invention for drawing 13 is shown. Drawing 13 A to drawing 13 D is the sectional view of a component showing the process. 1122, field oxide 1123, the polycrystalline silicon / silicon oxide gate 1124, P high concentration diffusion layer 1125, N high concentration diffusion layer 1126, etc. were formed in N minus silicon substrate 1120 1121 or P layers of layers P well by the usual approach (drawing 13 A). Next, the insulator layer 1127 of phosphorus glass (PSG) was put, dry etching of the insulator layer 1127 was carried out, and the contact hole 1128 was formed (drawing 13 B).

[0056] Next, W/TiN electrode wiring 1130 material was put by the usual approach, the sensitization agent 1129 was applied on it, and pattern NINGU of the sensitization agent 1129 was performed using the electron-beam-lithography approach of this invention (drawing 13 C). And the W/TiN electrode wiring 1130 was formed by dry etching etc. Next, the interlayer insulation film 1131 was formed and the hole pattern 1132 was formed by the usual approach. The inside of the hole pattern 1132 embedded with W plug, and connected the 2nd wiring 1133 of aluminum (drawing 13 D). Subsequent passivation processes used the conventional method.

[0057] In addition, although only the main production processes were explained here, the same process as a conventional method was used except having used the electron-beam-lithography approach of this invention at the lithography process of W/TiN electrode wiring formation. According to the above process, the pattern could be formed without quality deteriorating and CMOSLSI was able to be manufactured by the high yield. As a result of manufacturing a semiconductor integrated circuit using the electron-beam-lithography approach of this invention, when writing speed improved, the volume increased.

[0058]

[Effect of the Invention] According to this invention, it becomes possible to draw with the respectively optimal current density by the package graphic form method and the good conversion form method, and improvement in writing speed is obtained as a whole.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
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TECHNICAL FIELD

[Field of the Invention] This invention relates to the electron-beam-lithography approach and electron-beam-lithography system which are used for processing of a semiconductor integrated circuit, the photo mask for semi-conductor circuit apparatus, etc., and drawing.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Detailed-ization of the circuit pattern which forms LSI with the densification of a semiconductor circuit made into representation and high integration is progressing quickly. In order for an electron beam lithography to form a detailed pattern, it is an effective means, but in order to apply to a production site, the still higher throughput is demanded.

[0003] Many of electron beam exposure systems use the so-called good conversion form method which forms the beam of an adjustable rectangle. However, since the circuit pattern made it detailed, the number of patterns per sample increased and the further high throughput was required, the area beam of a good conversion form method was utilized, a mass of aperture diaphragm with a specific function was irradiated, and the package graphic form method which draws with the electron beam of a pattern configuration was developed. Moreover, opening of a package graphic form is enlarged like the publication to JP,10-199796,A, and the method which draws by scanning an opening top, and the method which draws by synchronizing this, beam deflection, and a sample stage while moving package opening to the patent No. 3034285 official report like a publication are also proposed. JP,5-251317,A and Japanese who developed this Journal OBU Applied The method which prepares the opening mold or dispersion mold mask of a semiconductor integrated circuit full chip like an optical imprint, and imprints with the beam of a comparatively big area like physics (Jpn.J.Appl.Phys.), 34 volumes (1995), and a 6658-page publication is proposed. Since all these methods are the approaches of drawing while projecting a mask image on a sample with an electron lens and positioning with deflecting system, on these specifications, they name these generically and call them a package graphic form method.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, it becomes possible to draw with the respectively optimal current density by the package graphic form method and the good conversion form method, and improvement in writing speed is obtained as a whole.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The main factor which determines the throughput of the above electron beam exposure systems is the current value of the electron beam (one shot) which irradiates at once on a sample. When a beam current value is enlarged, there is a problem on which the pattern configuration formed for the beam dotage by the coulomb effectiveness deteriorates. Therefore, although the good conversion form method which draws in a small beam area is good if current density which broke the beam current value by beam area is made high, by the package graphic form method which imprints a big area relatively, a current value will become large and a pattern configuration will deteriorate. On the other hand, if current density is made low, the drawing time amount in a good conversion form method will become long.
[0005] In case one sample is drawn like a publication to JP,11-219879,A as opposed to this problem, by the good conversion form method, it is [area / beam] small high in current density, and if it draws with the greatest current value in the range which changes current density and the coulomb effectiveness allows so that current density may be relatively made small for beam area greatly, writing speed will improve with a package graphic form method. However, in this example, as a means to change current density, since the condensing lens is used, a beam spread angle will also change to coincidence at the same time current density changes. The beam dotage by the coulomb effectiveness is proportional to an outline current value, and in inverse proportion to an aperture angle. Moreover, current density is proportional to the square of ******** in this case. Therefore, under the amount regularity of currents, an aperture angle will be set to 1/root2 as for 1/2 in current density with a condensing lens, and the coulomb effectiveness will increase.
[0006] This invention aims at performing an electron beam lithography at a high speed, preventing increase of the coulomb effectiveness. Furthermore, it aims at offering the electron-beam-lithography system which can realize the electron-beam-lithography approach for using a different combination effectively, and this.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In order to attain said purpose, in this invention, an electron beam lithography is performed at a high speed by combining a different drawing method and an electron beam exposure system with current density. First, it divides into the part which draws the pattern data which draw by the good conversion form method with data division equipment, and the part which draws by the package graphic form method, and two pattern data are created. Next, the pattern data of the part which draws in a good conversion form are assigned to an electron beam exposure system with high brightness, and the part which draws by the package graphic form method is assigned to an electron beam exposure system with low brightness. By drawing separately one sample which should draw with these two equipments, it can draw with the optimal current density and high-speed drawing is attained. Brightness is the amount of currents per unit area unit solid angle. Therefore, it becomes possible to change current density, without opening by changing brightness and changing an angle, and Lycium chinense becomes possible without changing the coulomb effectiveness under the amount regularity of currents.
[0008] The number of partitions of pattern data should just be made to draw by not being restricted to two, but dividing pattern data further depending on the difference of the drawing time amount between two equipments, and the magnitude of a package graphic form, and assigning each pattern data to another drawing equipment.
[0009] That is, the electron-beam-lithography approach by this invention is characterized by drawing in one sample using two or more electron optics systems from which brightness differs in the electron-beam-lithography approach which irradiates an electron beam at a sample and draws a pattern.
[0010] Two or more electron optics systems can be made into two or more combination in the electron optics system which performs pattern drawing by the good conversion form method, the electron optics system which performs pattern drawing by the package graphic form method, and the electron optics system which performs pattern drawing of a large area by the imprint method. These electron optics systems may be included in one electron beam exposure system, and may constitute an electron beam exposure system with separate each.
[0011] In the electron-beam-lithography approach which the electron-beam-lithography approach by this invention irradiates an electron beam again at a sample, and draws a pattern The process which divides the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, The part which draws by the good conversion form method is drawn according to the electron optics system which performs pattern drawing by the good conversion form method. The brightness of the electron optics system which performs pattern drawing by the good conversion form method is characterized by being higher than the brightness of the electron optics system which performs pattern drawing by the package graphic form method including the process which draws the part which draws by the package graphic form method according to the electron optics system which performs pattern drawing by the package graphic form method.
[0012] You may make it divide further the part which draws by the package graphic form method on the occasion of division of pattern data according to the class or area of a package graphic form. Moreover, you may make it divide further the pattern data of a method with the long drawing time amount of the part which draws by the good conversion form method based on the computed drawing time amount, and the part which draws by the package graphic form method.
[0013] In the electron-beam-lithography approach which the electron-beam-lithography approach by this invention uses together a good conversion form method and a package graphic form method again, and draws a pattern in a sample The process which divides the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, The process which computes the drawing time amount of the divided pattern data, the electron optics system which performs pattern drawing by the good conversion form method based on the computed drawing time amount, and the process which adjusts the brightness of the electron optics system which performs pattern drawing by the package graphic form method, It is characterized by including the process which draws in one sample according to the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method.

[0014] The electron-beam-lithography system by this invention is an electron-beam-lithography system including the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. A pattern division means to divide the pattern data which draw into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, A drawing time amount calculation means to compute the drawing time amount of the divided pattern data, A means to adjust the brightness of the electron optics system which performs pattern drawing by the good conversion form method based on the computed drawing time amount, and the brightness of the electron optics system which performs pattern drawing by the package graphic form method, It has a sample conveyance means to convey a sample, between the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. It is characterized by drawing in one sample using the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method.

[0015] The electron-beam-lithography system by this invention is an electron-beam-lithography system which includes the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method again. A means to perform the exposure amendment operation for the proximity effect correction of the pattern data which draw, A pattern division means to divide the pattern data by which the dose amendment operation was carried out into the part which draws by the good conversion form method, and the part which draws by the package graphic form method, A drawing time amount calculation means to compute the drawing time amount of the divided pattern data, A means to adjust the brightness of the electron optics system which performs pattern drawing by the good conversion form method based on the computed drawing time amount, and the brightness of the electron optics system which performs pattern drawing by the package graphic form method, It has a sample conveyance means to convey a sample, between the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method. It is characterized by drawing by carrying out proximity effect correction to one sample using the electron optics system which performs pattern drawing by the good conversion form method, and the electron optics system which performs pattern drawing by the package graphic form method.

[0016] The electron optics system which performs pattern drawing by the good conversion form method of said electron-beam-lithography system, and the electron optics system which performs pattern drawing by the package graphic form method may be included in one electron beam exposure system, and may constitute an electron beam exposure system with separate each.

[0017] Moreover, said electron-beam-lithography system combines between two or more electron beam exposure systems in a vacuum chamber, and, as for a sample conveyance means, it is desirable to move in the inside of the vacuum chamber, and to convey a sample to an electron beam exposure system. Moreover, a sample conveyance means is conveyed in an electron beam exposure system, carrying a sample in a sample maintenance means, and a superposition error can be reduced if it is made to draw, carried in the sample maintenance means.

[0018] In case it draws by setting the divided pattern data by one sample using two or more electron optics systems, it is desirable to use optical alignment mark detection equipment. Moreover, it is desirable that each doubling drawing algorithm at the time of drawing by setting the divided pattern data by one sample using two or more electron optics systems is the same. The electron-beam-lithography approach of this invention or an electron-beam-lithography system can be used for pattern drawing of a semi-conductor circuit apparatus or the photo mask for semi-conductor circuit apparatus.

[0019]

[Embodiment of the Invention] Hereafter, this invention is explained to a detail using a drawing. First, the configuration of the electron beam exposure system used by this invention is explained. The example of the electron beam exposure system of a package graphic form method is shown in drawing 14 . The example shown here is equipment which parts other than a package graphic form can also draw [of the good conversion form method using the variable shaped beam method which can change the magnitude of a ** type beam].

[0020] The electron beam 1202 emitted from the electron gun 1201 is irradiated on the 1st mask 1203 with rectangular opening, and image formation is further carried out on the 2nd mask 1205. The image of the 2nd mask 1205 draws by carrying out a projection deviation with reducing glass 1206 and the object deviation lens 1207, and being projected on the sample 1208 to which the sensitization agent was applied. This part is an electron optics system. At this time, opening of two or more pattern configurations established beforehand is chosen as the 2nd mask 1205 with the selection deflecting system 1204. Except the field which can be deflected with the object deviation lens 1207, it draws by moving the sample 1208 installed on X-Y stage 1209 with the X-Y stage control unit 1213. The whole drawing is systematically controlled by the drawing control unit 1210 according to drawing pattern data. Migration of the 2nd mask 1205 is performed by the mask migration device 1211, and it is controlled by the migration

device control unit 1212 according to a drawing pattern. It can also draw moving the 2nd mask 1205. Moreover, there is also a method which draws by carrying out the synchronized drive of the 2nd mask 1205 and X-Y stage 1209 using larger opening than the magnitude of the electron beam irradiated on the 2nd mask 1205.

[0021] The plan of the 2nd mask 1205 is illustrated to drawing 15 . On this 2nd mask 1205, the opening 1301 for package graphic forms is arranged around the opening 1302 for good conversion forms. In this example, five openings 1301 for package graphic forms are selectable at selection deflecting system.

[0022] Next, the example of the electron beam exposure system of an imprint method is shown in drawing 16 . A mask 1405 top is partially irradiated to the electron beam 1402 generated in the illumination system 1401 containing an electron source, acceleration space, a lens, etc. with a lens 1403 and deflecting system 1404. There are two methods, the dispersion mold which formed the pattern with the quality of the material with the large atomic number on the silicon thin film etc., and the opening mold which makes a hole in a silicon thin film, in this mask 1405. It is the method with which all give contrast with the difference of dispersion with the pattern section and the non-pattern section. In a mask 1405, incidence of the beam passed or scattered about is carried out to the 1st projection lens 1406 by deflecting system 1407, and only the scattered beams are cut by the limit aperture 1408. The beam which passed the limit aperture 1408 is positioned by the 2nd projection lens 1409 and deflecting system 1410, and is projected on a sample 1411. The 1st projection lens 1406 and the 2nd projection lens 1409 have doublet composition, and a projection scale factor is decided by the ratio of the focal distance of two lenses. For example, the pattern of 1mm angle is reduced to one fourth on a mask 1405, and it projects on 250-micrometer square on a sample. This configuration can also project aberration, such as distortion and dotage, few. Also mechanically, it moves to deviating with deflecting system 1404, and coincidence, and the current beam position on a mask 1405 draws synchronizing with the stage (not shown) in which a sample 1411 is carried.

[0023] The function and configuration which draw while irradiating a mask with an electron beam, projecting a mask image on a sample with two drawing equipments shown above and determining an electron beam location on deflecting system and a sample stage are the same. Therefore, on these specifications, these are named generically and it considers as a package graphic form method.

[0024] Hereafter, the detail of this invention is explained using a drawing.

[Gestalt 1 of operation] Drawing 1 is the system configuration Fig. showing an example of the electron-beam-lithography system by this invention. Electron beam exposure systems 111, 121, and 131 are electron beam exposure systems same type as having been shown in drawing 14 . The pattern data 103 which should draw are divided into good conversion form data and package graphic data by data division equipment 102. And it is sent to the control units 112, 122, and 132 which control electron beam exposure systems 111, 121, and 131, respectively. The sample drawn moves by the sample transport device 101 which operates within a vacuum chamber 106 between electron beam exposure systems 111, 121, and 131, and drawing is performed according to the divided pattern data. Actuation of drawing is the same as what was shown by drawing 14 .

[0025] The drawing time amount of each divided pattern data is computed with the drawing time amount arithmetic unit 105. Drawing time amount multiplies the sum of the shot residence time decided from the sensibility and current density of a sensitization agent of a sample, and the beam deflection latency time by the shots per hour, and if the whole overhead time is added further, it can ask for it. Here, suppose that the drawing time amount of for example, the package graphic form section was twice [about] the drawing time amount of the good conversion type section. In this case, it is the most efficient, if the good conversion type section is drawn with an electron beam exposure system 111 and the package graphic form section is drawn with electron beam exposure systems 121 and 131. Moreover, the brightness of each electron optics system may be decided so that it may become the current density of an integral multiple (here twice).

[0026] The sequence of drawing is shown in drawing 2 . First, equipment 111 is loaded with a sample 2 and equipment 131 is loaded with equipment 121 and a sample 3 for a sample 1, respectively. Since drawing of the sample 1 by the electron beam exposure system 111 which draws the good conversion type section is ended by the time amount of the one half of other equipments, after drawing termination of a sample 1, a sample 1 is evacuated and drawing of a sample 4 is started. next, after the drawing termination by each equipment and a sample 1 -- a sample 3 is moved to equipment 111 and evacuation and a sample 4 are moved for a sample 2 to equipment 121 to equipment 131. After drawing with an electron beam exposure system 111, a sample 2 serves as drawing termination, it loads equipment 111 with a sample 3 continuously, and starts drawing. It means that drawing of samples 3, 4, and 1 is mostly ended to coincidence, and, as for all of four samples, drawing was performed. Henceforth, this procedure is repeated similarly. These procedures are controlled by the drawing procedure control unit 104 based on the drawing time amount found with the drawing time amount arithmetic unit 105.

[0027] Drawing 3 is the example of the pattern which draws. They are the part which a part when it is the pattern of a repeat among the drawing patterns 31 draws with a package graphic form, and the part into which a lower part draws in a good conversion form. This drawing pattern 31 is divided and the pattern of the package graphic form pattern 32 and the good conversion form pattern 33 is generated. The good conversion form pattern 33 divided with the data

division equipment 102 shown in drawing 1 is sent to a control unit 112, and the package graphic form pattern 32 is sent to control units 122 and 132.

[0028] Next, both are described about the current density of a formula. For example, the magnitude of the pattern which draws by the electron-beam-lithography system is about 0.1 micrometers. On the other hand, the magnitude of a package graphic form is for example, 5-micrometer angle, and there are many patterns with opening which dozens of% of beam usually passes. Here, if current density is the amount of currents, then the same current density per unit area, the beam current of a package graphic form will become large 10 or more times as compared with a good conversion form.

[0029] On the other hand, if the beam dotage by the coulomb effectiveness has the the same specification of an electron optics system, it will become large proportionally mostly at a beam current value. Therefore, if the beam current of a package graphic form is restricted by the beam dotage by the coulomb effectiveness, and the current density in a good conversion form becomes small and it approves to the same beam dotage as a package graphic form, it is possible to raise current density. It is difficult practically to realize the electron optics system which must perform the change of the good conversion type section and the package graphic form section at the high speed of beam deflection latency-time extent, and changes current density at this rate by the conventional drawing approach. Therefore, it becomes possible [the electron optics system], if the electron optics system which draws a package graphic form makes current density of the electron optics system which performs drawing of current density 5 A/cm2 and a good conversion form a setup called 40 A/cm2 beforehand to draw efficiently, for example. For example, by the pattern of drawing 3 , if 38 shots and a package graphic form set [a good conversion form] up the current density of the electron optics system of a good conversion form method by nine shots by 8 times the current density of the electron optics system of a package graphic form method, the drawing time amount of good conversion form drawing will serve as the abbreviation 1/2 of package graphic form drawing.

[0030] There are some approaches as a means to change current density. For example, the include angle which expects an electron gun, without changing a crossover location using a condensing lens as the Prior art described previously is changeable. However, by this approach, since brightness does not change, a beam spread angle will also change to current density and coincidence. The beam dotage by the coulomb effectiveness is proportional to an outline current value, and in inverse proportion to an aperture angle. On the other hand, a current value is proportional to the square of an aperture angle. For example, when setting current density of current density 40 A/cm2 to one fourth with a condensing lens by aperture angle 5mrad, in order to set current density to one fourth, it is necessary to open and to set an angle to one half of 2.5mrad(s). However, since the coulomb effectiveness is in inverse proportion to an aperture angle, if the same current is used by the good conversion form method and the package graphic form method, beam dotage will double in current density 40 A/cm2. Therefore, by this approach, it does not become solution of the beam dotage by the coulomb effectiveness.

[0031] Current density can be raised without opening on the other hand, if the brightness of an electron gun is raised, and changing an angle. The approach of raising brightness has a method of changing the electron source itself. However, it is a simple approach to change the electrical potential difference of the approach of changing heating conditions, and the electrode (Wehnelt) which presses down generating of a thermoelectron in the case of a source of a thermoelectron like LaB6. Moreover, there are also an approach of adding and controlling the electrode which brings about a lens operation in an electron gun, and the approach of superimposing a magnetic lens on an electron gun. For example, when the thermoelectron gun of LaB6 is used, the brightness which realizes current density 40 A/cm2 by aperture angle 5mrad is 5x105 A/cm2 str extent. Since current density is proportional to brightness, if it is set as 6.25x104 A/cm2 str by raising the Wehnelt electrical potential difference or it lowers whenever [stoving temperature], current density will become 5 A/cm2. In this example, brightness was changed by raising the Wehnelt electrical potential difference. Since an aperture angle did not change at this time, even if it used the same current by the good conversion form method and the package graphic form method, the beam dotage by the coulomb effectiveness was not able to change, but was able to use the beam current value same as a result.

[0032] Although the above-mentioned example shows an example with the short drawing time amount of a good conversion form method, depending on the pattern which draws, the drawing time amount of a good conversion form method may be long. In that case, what is necessary is to draw the good conversion type section with electron beam exposure systems 111 and 121, and just to draw the package graphic form section with an electron beam exposure system 131.

[0033] An electron beam lithography must be performed in a vacuum, in order to use an electron beam. Usually, after carrying out evacuation of the sample in a chamber different from a sample stage before drawing, it loads on a sample stage. In drawing continuously among two or more equipments, the futility of time amount performs atmospheric-air-izing and exhaust air each time. Therefore, a dead time will be lost, if between each equipment is combined in a vacuum chamber and a sample is moved within a vacuum chamber. In drawing 1 , the part surrounded with the broken line is a vacuum chamber 106, and the sample transport device 101 operates within this vacuum chamber 106. If a sample transport device can treat two or more samples at a time, the effectiveness of sample exchange will

become good.

[0034] It is drawing 4 which showed the example of the mounting gestalt of equipment. In this example, the sample transport device 44 which operates within a vacuum is installed in the center of three electron beam exposure systems 41, 42, and 43. Between this sample transport device 44 and three sample stages, sample exchange is possible. If there are two or more arms of the sample transport device 44 at this time, it will be efficient and sample exchange will be attained. Moreover, a sample transport device performs sample transfer with the sample cassette 46 in atmospheric air by sample exchange with the evacuation room 45. The evacuation room 45 is the most efficient, if it exhausts and-izing of the sample (here three) of the number of electron beam exposure systems and the same number can be carried out [atmospheric air] to coincidence.

[0035] Superposition precision becomes important in drawing the same sample with two or more drawing equipments. There is retention form of a sample as one of the factors of a superposition error. When a sample is carried in the sample supporting structure, a superposition error may increase by the curvature of a sample, distortion, etc. In order to avoid such an error, it draws by moving between two or more drawing equipments the whole sample supporting structure 51 shown in drawing 5 . Drawing 5 (a) shows the example of the sample supporting structure 51 in which drawing 5 (b) carried the glass mask 53 for the example of the sample supporting structure 51 which carried the wafer 52.

[0036] When performing an electron beam lithography, the CAD data for an LSI design are changed into the data for electron beam exposure systems, and delivery and a control device draw to the control device of an electron beam exposure system by controlling the deflecting system of an electron beam control device etc. based on the data. In case data are changed, the part which draws with a package graphic form deletes the pattern data of the part, and replaces them with the sign which shows a package pattern.

[0037] Actuation of pattern data division equipment is explained using drawing 6 R> 6. The pattern data 61 for electron beam lithographies consist of pattern data divisions 63 in which the sign which usually shows the magnitude Sagitta label of the drawing condition part 62 which has described the magnitude of the whole pattern, a number, the minimum drawing unit, etc., and each pattern, and a package graphic form is stored. This pattern data 61 is read and it divides into the package graphic form pattern data 67 which consist of the good conversion form pattern data 66 and the drawing condition part 62 which consist of a drawing condition part 62 and good conversion form data division 64, and package graphic form data division 65.

[0038] The processing flow of pattern data division is shown in drawing 7 . The pattern data 61 are read (step 11), and since the drawing condition part 62 is common, the drawing condition part 62 is outputted to the good conversion form pattern data 66 and the package graphic form pattern data 67, respectively (step 12). Next, the classification of the data contained in the pattern data division 63 is distinguished (step 13), good conversion form data are outputted to the good conversion form pattern data 66 (step 14), and package graphic data are outputted to the package graphic form pattern data 67 (step 15). It remains at step 16 and the existence of data is judged, and processing of step 13 to the step 16 is repeated until the output of all pattern data finishes. Consequently, two pattern data are created. At this time, the mask of a package graphic form shall be prepared beforehand. The package graphic data of the mask which is not prepared are outputted to good conversion form data. In addition, software may perform this data division or you may carry out by hardware.

[0039] [Gestalt 2 of operation] In the drawing approach shown in the gestalt 1 of operation, in the case of drawing by the package graphic form method, generally, since many patterns can be incorporated so that the area of the package graphic form which can draw is large, writing speed becomes quick by one exposure. However, in order to imprint distortion and dotage for a big area few, the component of the electron optics system of deflecting system etc. must be increased, and complicated control must be performed. for this reason -- for example, the details of the electron optics system which draws the package graphic form of 5-micrometer angle and the package graphic form of 250-micrometer angle on a sample differ. On the other hand, since the area of a package graphic form is large, the beam dotage by the coulomb effectiveness becomes small. As the gestalt 1 of operation described, in package graphic form drawing of 5-micrometer angle, the brightness of LaB6 electron source is 5x105 A/cm2 str extent. On the other hand, in package graphic form drawing of 250-micrometer angle shown in drawing 16 , since a mask projection scale factor is 1/4, it is necessary to irradiate a mask top with the beam of 1mm angle. For this reason, the electron source itself is enlarged and the large area is irradiated. For this reason, brightness is set as 1x102 - 1x103 A/cm2 str extent.

[0040] As shown in drawing 8 , a semiconductor integrated circuit 71 may divide and design the circumference circuit which connects these with the block with specific functions, such as the memory sections, such as RAM and ROM, the CPU section, the DSP section, and the gate array section. The block with a specific function occupies a comparatively big area on a semiconductor integrated circuit. For example, as for each functional block, the magnitude of a semiconductor integrated circuit 71 has the 2-5mm side to 10-20mm angle. Moreover, these functional block will be frequently used in many cases, once a design is completed. If these functional block draws using the mask of functional block which is some full chips in the imprint method in which full chip drawing as shown in drawing 16 is possible, synthetic writing speed will improve. It is necessary to divide the part of these functional

block from pattern data at this time. The area of a package graphic form is sufficient as the criteria of division, and they may embed the sign which specifies functional block at the time of an integrated-circuit design into pattern data, and may follow the sign.

[0041] What is necessary is an electron beam exposure system 111 to perform a circumference circuit, and to draw in the good conversion type section, and just to draw functional block of a large area with an electron beam exposure system 121 using the system shown in drawing 1 which combined three electron beam exposure systems 111, 121, and 131 as a drawing system, using an electron beam exposure system 131 as an imprint mold for drawing of the package graphic form section of small area. Thus, with the gestalt of,this operation, the imprint method conventionally used for the full chip imprint is applied partially. Although reuse cannot do the mask of a full chip comparatively [with high manufacture cost], if it uses for chisels, such as the reusable memory section, like this example, it becomes possible to control total mask cost, and the merit is large.

[0042] Moreover, there are some which need many classes of package graphic form depending on the pattern which draws. Usually, a package graphic form is chosen by deflecting an electron beam in electromagnetism. There is an upper limit in a selectable number on the structure of a system, and when using the number beyond it, it is necessary to move the mask for package graphic forms mechanically. Here, two electron optics systems for package graphic form drawing are prepared, and if the mask with which the configurations of each package graphic form differ is prepared, the twice as many parenchyma [as this] number of selections can be obtained.

[0043] The flow of the pattern data division processing at the time of being based on the area of a package graphic form to drawing 9 is shown. First, like the gestalt 1 of operation, pattern data are read (step 21) and a drawing condition part is outputted to good conversion form pattern data and package graphic form pattern data, respectively (step 22). Next, the classification of the data contained in pattern data division is distinguished (step 23), and good conversion form data are outputted at good conversion form pattern data (step 24). the maximum package graphic form area which package graphic data can draw [of each electron optics system] -- a reference value -- carrying out -- size relation with this reference value -- judging (step 25) -- a facet -- the package graphic data 1 (step 26) of a product and the package graphic data 2 (step 27) of a large area are outputted. It remains at step 28 and the existence of data is judged, and processing of step 23 to the step 28 is repeated until the output of all pattern data finishes.

[0044] Although the pattern data division processing shown in drawing 9 is based on the area of a pattern, step 15 in drawing 9 may be replaced with the class judging of a package graphic form, and two package graphic data may be outputted according to a class.

[0045] [Gestalt 3 of operation] In the drawing approach shown in the gestalt 1 of operation, when dividing pattern data and drawing with two or more electron beam exposure systems, a difference may appear in the drawing time amount between each equipment. By the pattern by which the graphic form which is greatly dependent on the pattern which should draw, for example, is regular occupies most, it becomes most drawing this according to a good conversion form in the pattern which the rate of package graphic form drawing becomes large, and is irregular. If a difference is in drawing time amount, writing speed will be restricted to the longer one of drawing time amount, and futility will produce it.

[0046] Drawing time amount is decided with parameters, such as a shots per hour, current density, sensibility of a sensitization agent, the beam deflection latency time, and stage transit time. Therefore, if the contents of the pattern which should draw are understood, it will become computable [drawing time amount]. What is necessary is to divide the pattern data of the longer one further and just to lessen the difference of drawing time amount, if there is a twice [more than] as many difference as this at this time, for example, drawing time amount. Moreover, when there are three electron beam exposure systems, pattern data with longer drawing time amount are divided unconditionally, and you may make it surely generate three pattern data for example.

[0047] The flow of the latter example is shown in drawing 10 . First, like the gestalt 1 of operation, pattern data are read (step 31) and a drawing condition part is outputted to good conversion form pattern data and package graphic form pattern data, respectively (step 32). Next, the classification of the data contained in pattern data division is distinguished (step 33), good conversion form data are outputted to good conversion form pattern data, and (step 34) and package graphic data are outputted to package graphic form pattern data (step 35), respectively. It remains at step 36 and the existence of data is judged, and processing of step 33 to the step 36 is repeated until the output of all pattern data finishes. In this way, pattern data are divided into good conversion form data and package graphic data. Then, the drawing time amount of each pattern data is calculated (step 37), and drawing time amount is judged (step 38). At this time, if the drawing time amount in the direction of good conversion form pattern data excels, good conversion form pattern data will be divided further (step 39). If the drawing time amount in the direction of package graphic form pattern data excels, package graphic form pattern data will be divided further (step 40). Thus, drawing time amount can be shortened by drawing using three electron beam exposure systems.

[0048] [Gestalt 4 of operation] By the drawing approach shown in the gestalt of said the operation of each, in order to divide one pattern and to draw using two or more electron beam exposure systems in one sample, the superposition precision of the pattern between two or more equipments becomes important. As for the superposition in an electron

beam lithography, it is common to detect two or more mark locations on a sample using an electron beam, and to draw according to a configuration. However, when the current density and beam area of an electron beam differ from each other like this invention, the mark location detection precision which is to the base of superposition precision may change with between each equipment.

[0049] In order to cancel this difference, it is good to use the mark location detection not using an electron beam. The optimal means is optical detection from a viewpoint of detection precision. An example is shown in drawing 11 R> 1. Only the parts of the objective lens 1207 of the electron beam exposure system explained by drawing 14 , a sample 1208, and X-Y stage 1209 are shown in drawing 11 . Drawing 11 (a) is an example which measures the same location as an electron beam 1202. Incidence of the light is aslant carried out from the light source 91 to a sample, optical mark detection ****** 92 detects the image on a sample, and a location is measured. Drawing 11 (b) is an example which measures a different location in an electron beam 1202. If the relative position of optical mark detection ****** 93 and an electron beam 2 is proofread beforehand, it will become convertible [a mark location and a drawing location]. At this time, what doubled for photodetection what was doubled for electron beam detection is sufficient as the configuration of a mark.

[0050] [Gestalt 5 of operation] As the gestalt 4 of operation described, in case superposition drawing is performed, it is common to detect two or more mark locations on a sample, and to draw according to a configuration. Although precision will improve if the number of the marks to detect is increased, detection takes time amount. Therefore, the number of the marks detected in the range which can secure a required precision was limited, and the pattern which should draw has taken the approach of diffusing an error according to a location.

[0051] A wafer 1001 is used for a sample at drawing 12 , and the example in the case of drawing two or more chips 1002 is shown. Indispensable mark location detection is detection of the wafer alignment mark 1003 in the pattern area exterior. If these two or more marks are detected, the position error and rotational error when loading equipment with a sample are computable. What is necessary is just to draw based on this value as chip arrangement. In order to perform highly precise drawing, two or more chip alignment marks 1004 of the perimeter of a chip can be detected, and an X-Y stage migration error and a chip array error can be reduced. For example, the approach of taking four angles and cores of the whole chip, and the whole chip may be divided up and down, and you may draw by doubling in the block unit for every six chips. Moreover, the mark location of four angles may be detected for every chip, and you may draw according to this.

[0052] If an algorithm which was explained above is made the same with each electron beam exposure system, the difference between the equipment of a superposition error will be made to min. However, you measure separately a parameter which is different with each equipments, such as the shape of how to move an X-Y stage and a distorted form of an electron beam deviation, and, naturally make it reflected in superposition drawing.

[0053] [Gestalt 6 of operation] The proximity effect is in a problem peculiar to an electron beam lithography. It is the practical approach of amending the proximity effect at a high speed to calculate extent of effect beforehand according to the roughness and fineness of the pattern which should draw, and to change the exposure at the time of drawing. Since the proximity effect is influenced of all surrounding patterns, if it divides drawing data like this invention and a proximity-effect-correction operation is performed after that, it cannot obtain a right result. In the system shown in drawing 1 , an area consistency map is computed there by adding the exposure amendment calculation function for performing proximity effect correction to data division equipment 102. And in advance of data division, an area consistency map operation is performed to data division and coincidence. Drawing is started after sending the pattern data and the area consistency map which were divided here to control units 112, 122, and 132, respectively.

[0054] The exposure amendment calculation function may be built in the control unit of equipment. In that case, delivery area consistency map calculation is first performed [data before being divided] for example, for control unit 112 **. This map is transmitted to control devices 122 and 132, and the pattern data divided by data division equipment 102 based on this area consistency map are drawn.

[0055] [Gestalt 7 of operation] The production process of a semiconductor integrated circuit which used the electron-beam-lithography approach of this invention for drawing 13 is shown. Drawing 13 A to drawing 13 D is the sectional view of a component showing the process. 1122, field oxide 1123, the polycrystalline silicon / silicon oxide gate 1124, P high concentration diffusion layer 1125, N high concentration diffusion layer 1126, etc. were formed in N minus silicon substrate 1120 1121 or P layers of layers P well by the usual approach (drawing 13 A). Next, the insulator layer 1127 of phosphorus glass (PSG) was put, dry etching of the insulator layer 1127 was carried out, and the contact hole 1128 was formed (drawing 13 B).

[0056] Next, W/TiN electrode wiring 1130 material was put by the usual approach, the sensitization agent 1129 was applied on it, and pattern NINGU of the sensitization agent 1129 was performed using the electron-beam-lithography approach of this invention (drawing 13 C). And the W/TiN electrode wiring 1130 was formed by dry etching etc. Next, the interlayer insulation film 1131 was formed and the hole pattern 1132 was formed by the usual approach. The inside of the hole pattern 1132 embedded with W plug, and connected the 2nd wiring 1133 of aluminum (drawing 13 D). Subsequent passivation processes used the conventional method.

[0057] In addition, although only the main production processes were explained here, the same process as a conventional method was used except having used the electron-beam-lithography approach of this invention at the lithography process of W/TiN electrode wiring formation. According to the above process, the pattern could be formed without quality deteriorating and CMOSLSI was able to be manufactured by the high yield. As a result of manufacturing a semiconductor integrated circuit using the electron-beam-lithography approach of this invention, when writing speed improved, the volume increased.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The system configuration Fig. showing an example of the electron-beam-lithography system by this invention.
[Drawing 2] Drawing showing the example of the drawing sequence in two or more electron optics systems.
[Drawing 3] Drawing showing the example of division of a drawing pattern.
[Drawing 4] Drawing showing the mounting gestalt of an electron-beam-lithography system.
[Drawing 5] Drawing showing an example of the sample supporting structure.
[Drawing 6] Drawing showing the example of division of drawing pattern data.
[Drawing 7] Drawing showing the division flow of drawing pattern data.
[Drawing 8] Drawing showing the example of a configuration of a semiconductor integrated circuit.
[Drawing 9] Drawing showing the flow which divides pattern data in the area of a package graphic form.
[Drawing 10] Drawing showing the flow re-divided based on the drawing time amount of the divided drawing pattern.

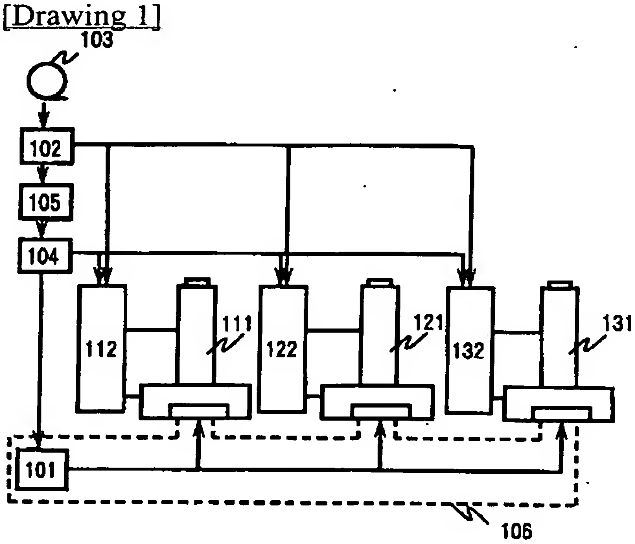
[Drawing 11] Drawing showing the example of a configuration of an optical mark detection machine.
[Drawing 12] Drawing showing the drawing chip on a wafer, and the example of an alignment mark.
[Drawing 13] Drawing showing the process which creates a semiconductor integrated circuit by the electron-beam-lithography approach of this invention.
[Drawing 14] Drawing showing the conventional electron beam exposure system.
[Drawing 15] Drawing showing a package graphic form mask.
[Drawing 16] Drawing showing the electron beam exposure system of the conventional imprint method.
[Description of Notations]
A sample transport device, 102:data division equipment, 103 : 101: Pattern data, 104: A drawing procedure control unit, a 105:drawing time amount arithmetic unit, 106 : A vacuum chamber, 111:electron beam exposure system 1,112: -- a control device and a 121:electron beam exposure system 2,122:control device -- 131:electron beam exposure system 3,132: -- a control unit and 31 :drawing patterns -- 32: A package graphic form pattern, a 33:good conversion form pattern, the 41:electron beam exposure system 1, the 42:electron beam exposure system 2, the 43:electron beam exposure systems 3 and 44 : A sample transport device, 45: An evacuation room, 46:sample cassette, 51:sample supporting structure, 52 : A wafer, 53: A glass mask, 61:pattern data, 62:drawing condition part, 63 : Pattern data division, 64: Good conversion form data division, 65:package graphic form data division, 66 : Good conversion form pattern data, 67: Package graphic form pattern data, 71:semiconductor integrated circuit, 1202 : An electron beam, 1207 : An objective lens, a 1208:sample, a 1209:X-Y stage, 91 : The light source, 92:optical mark detection equipment, 93:optical mark detection equipment, 1001 : A wafer, a 1002:chip, a 1003:wafer alignment mark, 1004 : A chip alignment mark, a 1120:N minus silicon substrate, 1121 :P a well -- a layer and 1122 :P a layer and 1123:field oxide -- 1124: Polycrystalline silicon / silicon oxide gate, 1125 :P High concentration diffusion layer, 1126: N high concentration diffusion layer, a 1127:insulator layer, 1128 : A contact hole, 1129: A sensitization agent, 1130:W/Ti electrode wiring, 1131 : An interlayer insulation film, 1132: A hole pattern, the 2nd wiring of 1133:aluminum, 1201 : An electron gun, 1202: -- an electron beam and 1203: -- the 1st mask and 1204:selection deflecting system -- 1205 : The 2nd mask, 1206:reducing glass, a 1207:objective lens, 1208 : A sample, a 1209:X-Y stage, a 1210:drawing control unit, 1211: A mask migration device, a 1212:migration device control device, 1213 : An X-Y stage control device, 1301: Opening for package graphic forms, opening for 1302:good conversion forms, 1401 : An illumination system, 1402: -- an electron beam, a 1403:lens, 1404:deflecting system, a 1405:mask, the 1406:1st projection lens, and 1407: -- deflecting system, 1408:limit aperture, the 1409:2nd projection lens, 1410:deflecting system, and a 1411:sample

[Translation done.]

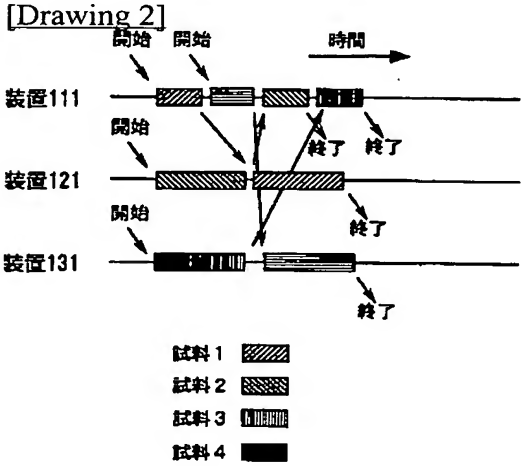
* NOTICES *

DRAWINGS

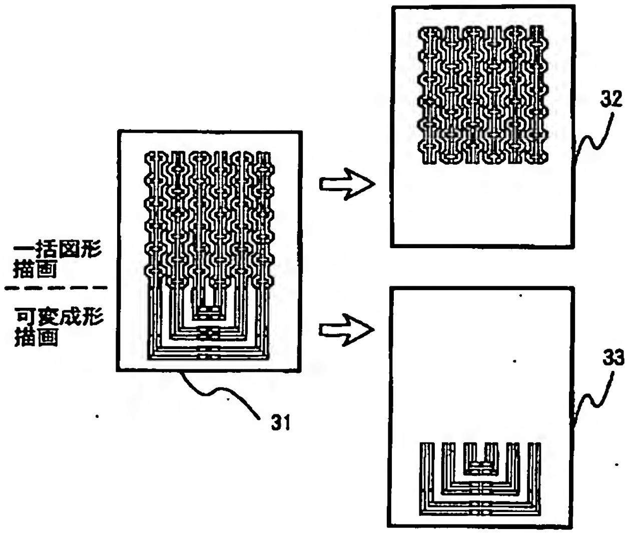
[Drawing 1]



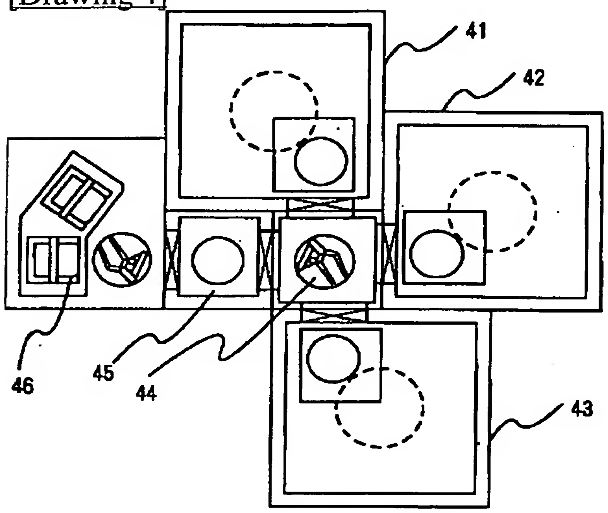
[Drawing 2]



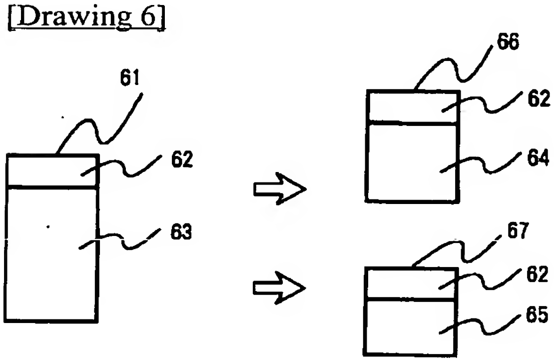
[Drawing 3]



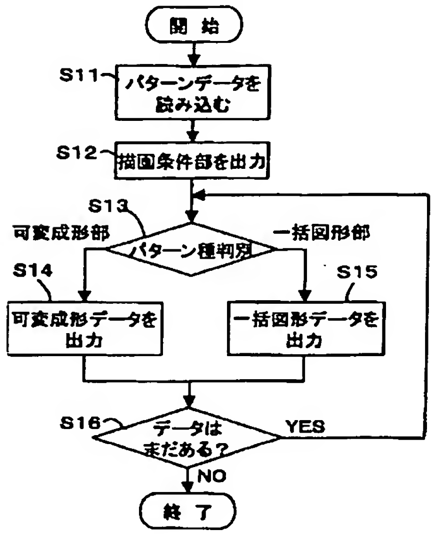
[Drawing 4]



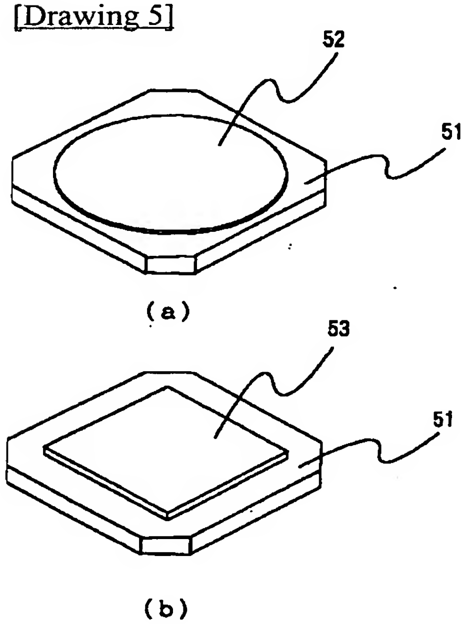
[Drawing 6]



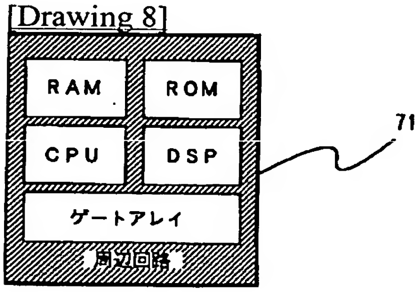
[Drawing 7]



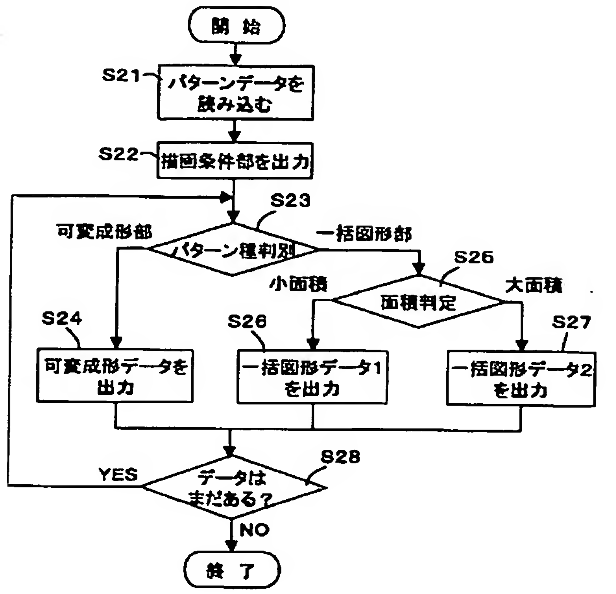
[Drawing 5]



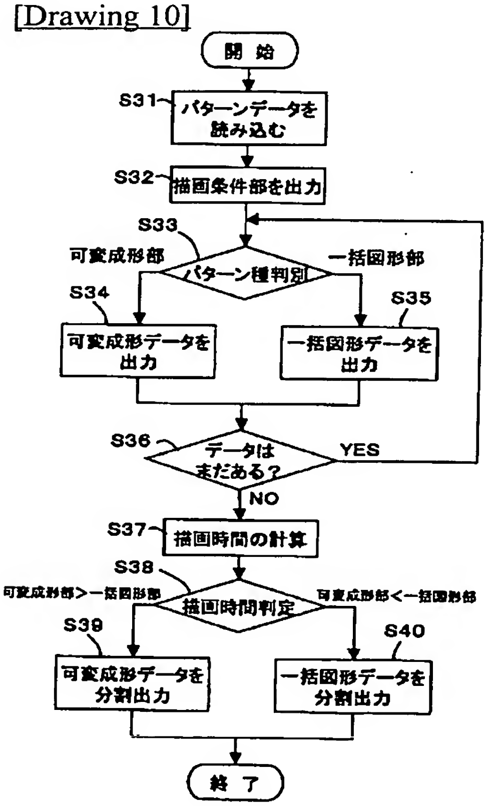
[Drawing 8]



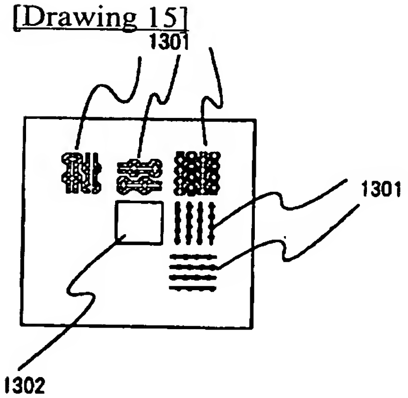
[Drawing 9]



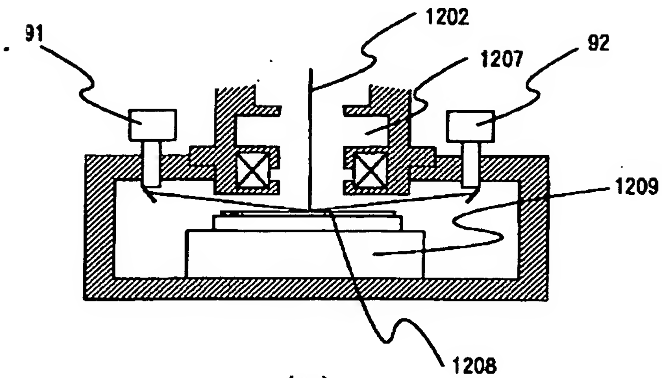
[Drawing 10]



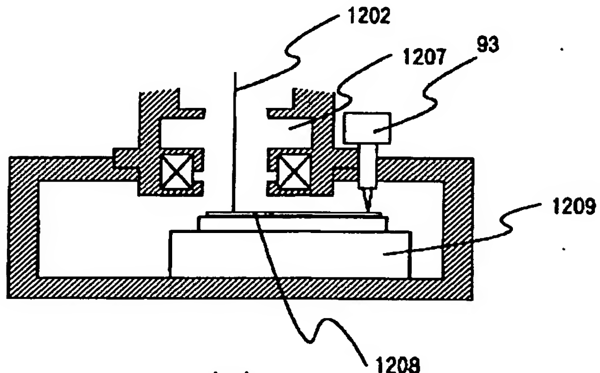
[Drawing 15]



[Drawing 11]

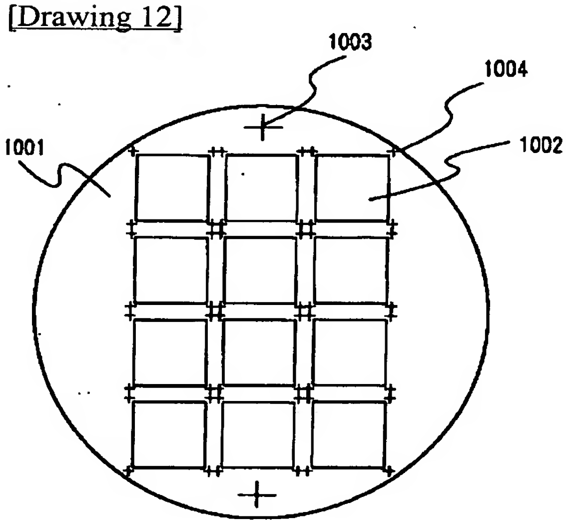


(a)

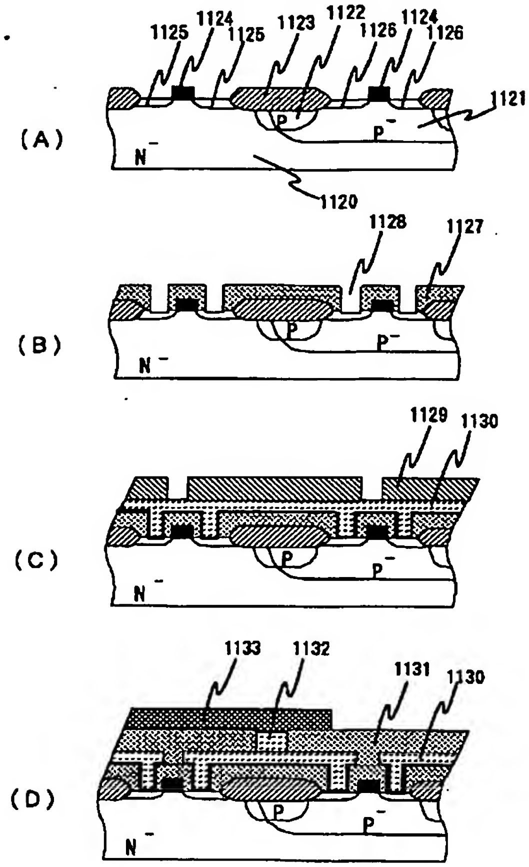


(b)

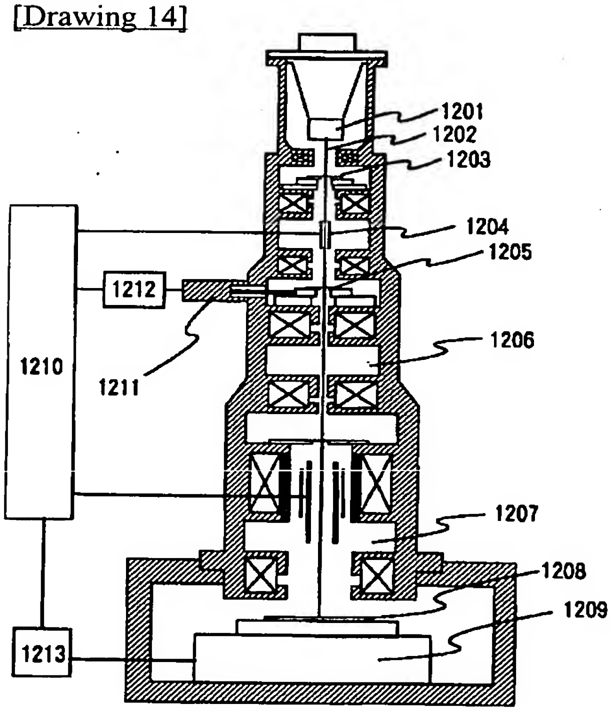
[Drawing 12]



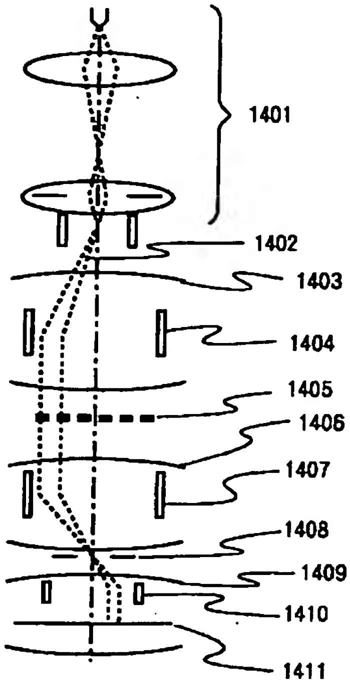
[Drawing 13]



[Drawing 14]



[Drawing 16]



[Translation done.]